Economic and Sociology
Studies Paper No. 549

ESTIMATION OF BASIS AND FORWARD PRICES FOR A HOG MARKET IN CENTRAL OHIO: A TECHNIQUE

E. Dean Baldwin

ESS 549

Department of Agricultural Economics and Rural Sociology
The Ohio State University
2120 Fyffe Road
Columbus, Ohio 43210

Introduction

With the advent of the live hog futures contract on the Chicago Mercantile Exchange and the Mid-American Exchange, hedging became an option for slaughter hog producers.[1/] A hedge involves the sale of a hog futures contract by a farmer on one of the exchanges during or prior to production. This differs from speculation in that the farmer has a tangible product to sell. A hedge reduces the farmers' price risk locking in a predictable price.[2/] To complete the hedge, an offsetting futures contract is bought through the futures market when the live hogs are sold on the cash market. This transaction in the futures market cancels the obligation to deliver hogs to a buyer through the futures market. Through these actions, the farmer establishes prices prior to the sale of the commodity.

Slaughter hog prices listed on the exchanges reflect the supply and demand expectations of speculators. These price quotes do not necessarily equal the forward price, that is, the actual price received by the farmer upon delivery of his hogs to market. To hedge, the farmer must estimate the forward price by continually studying and charting cash and futures price relationships. The difference between these two sets of prices is the basis which is used to determine the forward price.

1/ In 1966, the Chicago Mercantile Exchange listed the live hog futures contract.

2/ Prices are predictable if basis changes are estimated. In part, this paper treats the subject of basis changes and forward prices.

Determining the basis and the forward price is difficult for many producers. Experience has been limited as producers have only had the option of hedging for ten years. This option has not often been used as most farm operations were small and did not produce and sell enough hogs to fulfill a futures contract. To enter into a futures contract, the two exchanges have quantity requirements (Table 1).

Inexperience and quantity limitations are not the only factors inhibiting the determination of the basis and forward price by farmers. It is also difficult because historic cash and futures price data are difficult to acquire. Cash price data are not accurately reported for local areas within the state. Cash prices may vary among locations and through time because of differences in supply and demand relationships and differences in the quantity and quality of transportation facilities. Although future price data are well reported on a daily basis, annual historic data are only available from specialized sources.

A further complicating factor is the change in ending basis. Even though the ending basis may be estimated by averaging historic futures and cash price data, a basis for any one year may vary from the average because of unexpected differences in supply and demand relationships in either the cash or futures market. These changes in turn may alter the expected forward price, which was estimated by the farmer. This may cause some farmers to lock in an unexpected loss or profit. This uncertainty may be a barrier and prevent some farmers from hedging.

To help a producer estimate a basis and forward price, this paper compares the live hog futures contracts for the two exchanges. It also describes a method for determining a local basis. To exemplify this method, a local basis for seven contract months in central Ohio hog markets

TABLE 1. Live Hog Futures Contract Specifications and Request for the Chicago Mercantile Exchange and the MidAmerican Exchange (1977)

Contract Unit	Delivery Months	Delivery Points	Commission Per Contract[1]	Initial Margin[1]	Maintenance Margin[1]
		Chicago Mercantile Exchange			
30,000 lbs. of USDA Grade No. 1, 2, 3, or 4 barrows and gilts averaging 200-230 lbs.	Feb. Apr. June July Aug. Oct. Dec.	Peoria, Ill. Omaha, Neb. East St. Louis, Ill. Sioux City, Iowa St. Joe, Mo. St. Paul, Minn. Kansas City, Kansas	$45	$700	$500
		MidAmerican Exchange			
15,000 lbs. of USDA Grade No. 1, 2, 3, or 4 barrows and gilts averaging 200-230 lbs.	Feb. Apr. June July Aug. Oct. Dec.	Peoria, Ill. Omaha, Neb. East St. Louis, Ill. Sioux City, Iowa St. Joe, Mo. St. Paul, Minn. Kansas City, Kansas	$28	$350	$200

[1]Current charges should be obtained from a broker or the Exchanges.

SOURCE: MidAmerican Commodity Exchange and The Chicago Mercantile Exchange.

is presented. This study also illustrates how to forward price hogs using a basis. Lastly, it describes the method for calculating the variation (standard deviation) surrounding the basis. The latter technique estimates a predictable forward price range.

Futures Markets

Trading in the futures market is in contracts for future delivery or acceptance of a commodity at a delivery point. The price, the quality and quantity of the commodity, specific delivery time, and the location for delivery are included in the futures contract. A futures contract is an agreement between a buyer and a seller. The seller is selling a promise to deliver a specified commodity at some future date. This market position is defined as being "short the futures." A buyer is promising to accept and pay for some commodity at some future time. This transaction is defined as being "long the futures." Since the contracts are standardized, a sale or purchase of a contract can be cancelled (offset) by a purchase or sale of a second identical contract. Thus, within the exchange, contracts or promises are traded but sellers seldom deliver the actual physical commodity to buyers.

Live hog contracts are traded on the Chicago Mercantile Exchange and the Mid-American Exchange. Both are located in Chicago, are federally licensed, and are under the jurisdiction of the Commodity Futures Trading Commission. The major difference between the two Exchanges is the specification of the futures contract rather than any difference in objectives or organization. Contract details and trading regulations are summarized for each Exchange in Table 1. The delivery months and the delivery points are identical for each Exchange. The delivery months are those during which a futures contract expires and becomes subject to delivery. In other words,

hedgers or speculators may buy and sell futures contracts which obligate the trader to either take or make delivery in one of seven different time periods. The delivery points identify the location (city or stock yards) designated by the Exchange as authorized for placement of live hogs. If producers in Ohio elected to deliver hogs against a futures contract, the delivery could occur at any one of the seven points.[3/]

The Mid-American contract size is 15,000 pounds of hogs versus 30,000 pounds for the contract listed on the Chicago Mercantile Exchange. Quality factors or grades are identical. Commission per contract, initial margins, and maintenance margins vary by Exchange; however, the difference expressed in cents per pound is very small and would not be a predominant factor in the selection of an Exchange. The contract unit is the pounds of hogs per contract. The commission is the brokerage fee for entering and liquidating one contract of a commodity futures. The initial margin is "good faith" money deposited by the trader with the brokerage house and in turn deposited by the brokerage house with the Exchange. It is a guarantee that the trader will meet the financial obligations of the contract. Maintenance margins are monetary deposits required by the Exchange to keep a futures contract in force. This is required when the initial margin has been depleted by adverse price movements. If the trader does not supply the additional margin money, the brokerage house closes out (buys or sells) the open futures contract. Again, this assures that all financial obligations will be met by the buyers and sellers trading in futures contracts.

3/ Only in rare cases would an Ohio farmer deliver hogs against a contract. It would be difficult to ship a load of hogs to one of these distant points and meet the quality requirements.

Since the major difference in the two exchanges is the size of contract, the decision to hedge by selling a contract on either rests with the number of hogs that can be sent to market in one time period. A producer who can produce and market a maximum of 75 hogs weighing 200 pounds each at any one time may elect to hedge on the Mid-American Exchange. His volume prevents him from selling a contract on the Chicago Mercantile Exchange. A larger producer who can produce and sell 150 hogs weighing 200 pounds each at one time may elect to hedge on either Exchange. He may sell one contract on the Chicago Mercantile Exchange or two on the Mid-American Exchange. Hedging, by selling a contract on either Exchange, requires determination of a basis and basis range.

A Localized Basis: Procedures

The difference between the futures price and the local cash price is the local basis. The normalized local basis is an average local basis determined for a period of years. Determining the local and normalized basis is the most important element in the effective use of futures markets for forward pricing and hedging. Forward prices for the physical commodities are estimated by subtracting the local normalized basis from the selected futures price at the time the hedge is put into force.

The localized basis is determined using the following steps.

1. Obtain at least five years of daily or weekly cash quotes from a local stock yard, daily market, auction house, order buyer dealer, or packer. Secondary price data may be obtained from the Ohio Federal State Marketing Service or Statistical Reporting Service. The latter data are averages and do not reflect prices bid to an individual farmer. Thus, the calculated basis may be somewhat biased.

2. Obtain the closing price of the futures contract from the appropriate Exchange for the contract months in which the hogs will be sold. At least five years of data are required. These data may be obtained from the Wall Street Journal, local newspaper, or Statistical Annuals published by the Exchanges.
3. Select a futures and cash price for the same day for each year. Subtract the cash price from the futures price. The remainder is the basis for each year. The formula is:

   Basis = Futures Price in the contract month - Cash Price.
4. Derive the normalized local basis by averaging the annual bases.

   Normalized local basis =

$$\frac{\text{Annual Basis}_{(1)} + \text{Annual Basis}_{(2)} + \ldots + \text{Annual Basis last year}}{\text{Number of Years}}$$

To illustrate the determination of an annual ending basis and a normalized local ending basis, hypothetical data for a five year period are entered into the above formula. It is assumed that these data were collected on the 20th day (termination of trading for a specific contract) of a specific contract month. To derive accurate estimates of averages and variations around the average, the number of observations must be increased above the number in this example. In other words, a farmer who is collecting five years of data may want to collect 10 or more observations (one for each working day for the ending contract month) for each year. Averages would be calculated on at least (10 observations per year x 5 years) or 50 observations. An accurate estimate of the normalized local ending basis would thus be determined.

In this example, we assume that the cash prices for the five years were: $35, $33, $32, $37, and $39/cwt. For the second step, assume that

the following futures prices data were recorded \$37, \$33, \$34, \$38, and \$44/cwt. In the third step, the annual local ending basis is determined by subtraction. The basis for each of the five years would be:

\$37 - \$35 = \$2 basis for year 1

\$33 - \$33 = \$0 basis for year 2

\$34 - \$32 = \$2 basis for year 3

\$38 - \$37 = \$1 basis for year 4

\$44 - \$39 = \$5 basis for year 5

The fourth step generates the normalized local ending basis through the averaging technique:

$$\text{Normalized ending basis} = \frac{\$2 + \$0 + \$2 + \$1 + \$5}{5} = \$2/\text{cwt}$$

Thus, on the average the futures prices were \$2/cwt higher than the cash prices.

After the normalized basis is determined, the variation (standard deviation) in the basis is determined, and an estimate of the expected forward price is derived. These estimates are determined by the following standard deviation formulas:

$$s = \sum_{i=1}^{n} \frac{(\text{annual basis} - \text{normalized basis})^2}{\text{number of years} - 1}$$

For the above data:

$$s = \frac{(\$2 - \$2)^2 + (\$0 - \$2)^2 + (\$2 - \$2)^2 + (\$1 - \$2)^2 + (\$5 - \$2)^2}{5-1}$$

$$s = 1.87$$

Again, it is emphasized that in actual appreciation the number of observations must be significantly increased to obtain an accurate estimate of the standard deviation coefficient. Statistically, the standard deviation

estimates the variation of the annual basis observations about the normalized or average basis observation. In the above example, 67 percent of the time, the basis will range between $.13/cwt ($2 - $1.87) and $3.87/cwt ($2 + $1.87); 95 percent of the time the basis will range between -$1.74/cwt [2 - 2($1.87)] and $5.74/cwt [$2 + 2($1.87)]. These estimates represent likely intervals in which the basis will fall. In addition these intervals provide limits for determining the forward prices.

Localized Basis For Central Ohio Hog Markets

Using the above procedures, seven local bases were calculated for central Ohio hog markets (Table 2). Cash price data were prices bid to central Ohio farmers as reported by the Ohio Federal-State Marketing Service and live hog futures prices were those reported by the Chicago Mercantile Exchange. These data accurately estimate the annual ending basis and normative or average ending basis for an aggregated number of markets in central Ohio. To improve the accuracy of the estimate of the basis for any one local market, each farmer should determine the bases for his local area. Differences in supply and demand relationships alters the basis estimate from one region to another. In addition, new bases should be determined as new data become available; otherwise, the impact of the new trends will not be incorporated into the ending basis estimate. If new trends are not incorporated, the farmer's estimate of the forward price becomes obsolete or inaccurate through time.

Calculations of the ending bases for the central Ohio hog markets confirms that in most cases the futures prices are greater than the cash prices (Table 2). Theoretically, this is correct and the difference between the two, the basis, reflects the transportation costs for moving

TABLE 2. The Annual and Normalized Delivery Month Basis For Central Ohio Hog Markets, 1969-1975 $/CWT

Year	February	April	June	July	August	October	December
				Delivery Month			
1969	$1.25	$1.18	$1.05	$1.12	$ .73	$ .58	$1.63
1970	1.95	.87	.47	1.23	-.08[1]	.85	1.33
1971	1.27	.57	1.47	1.08	.50	.88	1.10
1972	1.02	1.00	1.02	1.15	-.10[1]	.60	.93
1973	1.10	.95	1.77	0	.85	1.07	1.70
1974	1.70	.84	- .85[1]	2.17	.82	1.87	.87
1975	1.22	2.22	.67	.52	1.25	2.57	2.22
Normalized (Average) Basis	$1.35	$1.09	$ .80	$1.03	$ .44	$1.20	$1.39
Standard Deviation (Variation Around The Average) Basis	.31	.49	.78	.62	.48	.68	.45
Normalized Basis Range 67% Confidence Limits	$1.04 to $1.66	$ .60 to $1.58	$ .02 to $1.58	$ .41 to $1.65	$-.04 to $ .92	$ .52 to $1.88	$ .94 to $1.84

[1]The negative signs indicate that the cash price in the local cash market is greater than the futures prices. In all other instances, the future price is greater than the cash price.

SOURCE: Schlenker, Tom, "The Implications of Economic Factors and Market Information Reports For Various Swine Marketing Strategies With Implications to the Changing Habits," Unpublished Master's Thesis, Ohio State University, 1976.

hogs from Ohio to a destination point such as Peoria, Illinois. In reality, localized supply and demand conditions may cause the basis to be less than the transportation costs, arbitrators (farmers, marketing personnel, packers) will begin to sell futures contracts and deliver hogs to Peoria. This market action by the arbitrators narrows the basis making it equal to the transportation costs because prices in the Ohio cash market are bid up and prices in the futures market are forced down.

By averaging the annual bases, the normalized basis is calculated for the given seven year period in Table 2. The variation surrounding (standard deviation) the normalized basis is also reported in Table 2. For the February contract month, for example, 67 percent of the time, the normalized basis will vary from $1.04 to $1.66; 95 percent of the time, the normalized basis will vary from $.73 to $1.97.

Because of differences in seasonal trends, the normalized basis and variation surrounding these bases vary from one contract month to another. Producers should not assume that one normalized basis for one contract month is transferrable to other contract months or periods. In a like token, producers should not assume that the normalized basis for a particular contract month is a substitute basis to estimate forward prices of hogs in a non-contract period such as March, therefore, the normalized basis is not transferrable for delivery of hogs in other months. To estimate a forward price, the normalized basis must be generated for each month that hogs will be delivered to the market.

Forward Pricing Hogs

The objective in forward pricing live hogs during production is to lock in a price prior to the actual sale of the hogs. To estimate the

forward price, one should calculate the normalized basis and the standard deviation. Subtracting the normalized basis from the futures price yields an estimate of the price to be received for the hogs at the time they are marketed. By introducing the standard deviation, probable basis variations or differences from the "most likely" basis are estimated and a predictable forward price range may be derived.

To estimate a forward price, assume that in July, 1974, a farmer knew that he would be able to market 30,000 pounds of hogs (150 head averaging 200 pounds each) in December through a daily market. He wants to lock in a favorable selling price (forward price) which will guarantee him a profit. This would eliminate either a windfall profit or unexpected loss from hog price changes.

The normalized basis for December is $1.39/cwt. with a standard deviation of $.45/cwt. (Table 2). He can be 95 percent sure that the forthcoming basis will range from $.49 to $2.29/cwt. The forward price for the hogs may be estimated by subtracting this range from the December futures price.

On July 31, 1974, the closing December futures price was $45.37/cwt. This implies an estimated local December price (forward price) ranging from $43.08/cwt. ($45.37 - $2.29, Basis) to $44.88/cwt. ($45.37 - $.49).[4] Assuming that it costs the farmer $40/cwt. to produce a 200 pound slaughter hog, a profit ranging from $3.08 to $4.88/cwt. could be anticipated. If this profit range represents an acceptable return for management and for risks, a December futures contract is sold by the farmer in July. This

---

[4]These calculations do not include margin or commission charges. The commission charges add about $.15/cwt. and margin charges vary with interest rates, size of margins, and changes in economic conditions.

initiates the hedge. The price is locked in and price risk is reduced considerably, compared to selling via the cash market. Assuming that the production cycle ends December 18, the hogs are sold through the daily market and a futures contract is bought by the farmer. In this example, the hedge is completed by trading hogs in the cash market and live hog futures contracts in the futures market. Table 3 details these transactions.

TABLE 3. Transactions For Forward Pricing Hogs: An Example

Date	Cash Market	Futures Market	Basis	Price	Profit
			.....$/CWT.....		
July 31	Sows Farrow	Sell Hog Contract $45.37	$.49 - $2.29[1]	$43.08 - $44.88[2]	$3.08 - $4.88[3]
Dec. 18	Sell Hogs in Daily Market $41.88	Buy Hog Contract $42.88	$1.00	$44.37[4]	$4.37
	Gain	$2.49			

[1]Normalized basis range.

[2]Expected (forward price) price range in December.

[3]Expected profit range in December ($43.08 - $40.00 = $3.08, $44.08 - $40.00 = $4.88).

[4]$41.88 (cash price) + $2.49 (gain) = $44.37. These calculations do not include margin or commission charges.

The net price received for the hogs was $44.37/cwt., the local selling price of $41.88/cwt. plus the $2.49 gain in the futures brought about the net price. This is within the expected range of $43.08 - $44.88/cwt. (previously calculated) illustrating that the change in the basis was anticipated. If only the normalized basis would have been used to estimate

the forward price, the estimate would have deviated by $.39/cwt. ($1.39 - $1.00 = $.39 change in basis). The profit per hog was $4.37/cwt. ($44.37 - $40.00 = $4.37). This too fell within the anticipated profit range.

Conclusions and Implications

To forward price hogs, producers should study the cash and futures price relationships. The difference between these two sets of prices represents the basis. The basis influences the estimated forward price. Cash price data should be obtained from local markets and should represent the producers selling options. If not available, secondary data may be employed. A basis must also be determined for each month in which hogs are to be sold. The basis for any one contract month is not applicable for other delivery times.

Farmers should maintain price records and prepare annual and normalized basis and variations (standard deviations) surrounding the basis. Because economic conditions change through time and historic statistics become obsolete, a producer must update the normalized basis. Otherwise, inaccurate forward prices will be estimated resulting in unforeseen losses or profits.

The farmer must know costs of operation if he is to reach the appropriate decision to forward price hogs. Otherwise, losses may be locked in rather than profits. It is important to note that a forward price does guarantee a fixed price but does not guarantee a profit. Some producers have been unhappy with their forward pricing decisions when they locked in a loss rather than a profit.

Farmers who need to lock in a price and thus avoid the risk of price change should find these techniques useful in developing swine hedging

and forward pricing programs. Intervals, which include the normalized or average basis and the forward price, 95 percent of the time, should be estimated. The success of the program will hinge upon the accuracy of these calculations, the adequacy of the price record keeping system, and the level of understanding associated with the forward pricing mechanisms and the hedging program.

GLOSSARY

Basis - The difference between a futures price and a cash price which reflects the cost of transportation to the delivery point plus the cost of storage, interest, and insurance until delivery date of the contract.

Cash Market - It is an "area of negotiations" in which commodities are exchanged from sellers to buyers. Included in this definition are terminals, daily hog markets, auctions, organizational pools, and sales to dealers, order buyers, and packers.

Commission - The brokerage fee for entering and liquidating one contract of a commodity future.

Delivery Months - That month during which a futures contract expires and becomes subject to delivery.

Delivery Points - Those locations (cities and/or elevators) designated by the exchange as authorized for placement of hogs in fulfillment of an expiring futures contract.

Ending Basis - The difference between a futures price and a cash price for a contract month in which a futures contract expires.

Forward Price - An estimated price for some futures date. Alternatively, it is the futures period minus the normalized basis or basis range.

Futures Contract - A term representing a contract specifying the date, location, grade and quantity of hogs to be delivered at a later date which is traded or an organized commodity exchange.

Futures Market - It is an "area of negotiations" in which futures contracts are exchanged from sellers to buyers. Although seldom exercised, the seller has an option to deliver the commodity and the buyer has an option to accept the commodity.

Hedge - To reduce risk of cash ownership or delivery obligation due to market price changes by buying or selling an offsetting amount of futures. Also to lock in a price by selling an amount of futures equal to anticipated production.

Initial Margin - The margin deposit required by the exchange when a new futures trade is entered.

Localized Basis - The difference between a futures price and a cash price for a specific market or marketing area. Bases may vary among marketings reflecting differences in supply and demand relationships, transportation costs, and storage costs.

Long the Futures - To buy a futures contract, and thus are obligated to accept delivery unless the position is offset before delivery date.

Margin Deposits - "Good faith" money deposit made with the brokerage house and in turn deposited by the brokerage house with the futures exchange. The minimum margin is determined by the exchange and is usually lower for hedgers than for speculators.

Normalized Basis - It is an average local basis or basis.
Alternatively normalized basis = $\frac{\text{basis year}_1 + \text{basis year}_2 + \ldots + \text{basis year}_N}{N}$

Short the Futures - To sell a futures and thus be obligated to make delivery unless the position is offset before delivery date.

Speculator - A non-hedging trader. One who assumes risk positions with the hope of making a profit rather than protecting inventory or guaranteeing production costs.